MED437
King Saud University

RADIOLOGY TEAM 437

Radiology of common brain diseases

Color Index:

- ✓ Important
- ✓ Notes
- ✓ Extra

Editting File

objectives:

Learn about:

- ➔ Intracranial hemorrhage
- ➔ Brain ischemia
- ➔ Intracranial tumors
- ➔ Intracranial infections

Check 436 teamwork if you are interested to know more details "they took two parts but we only took ONE LECTURE"

Sources

Lecturer:
Dr. Dimah Jamjoom
Same 436 lecture Slides/Team:
Mostly

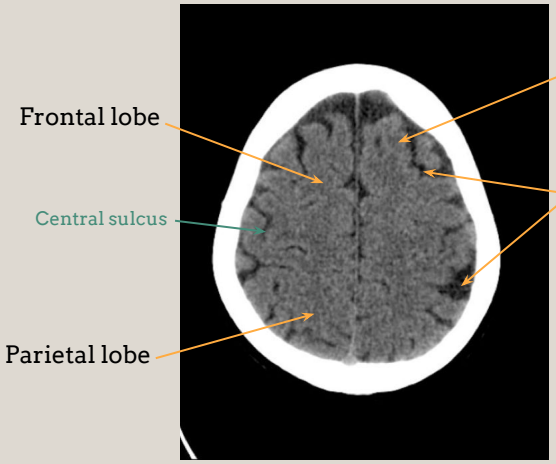
Done by:

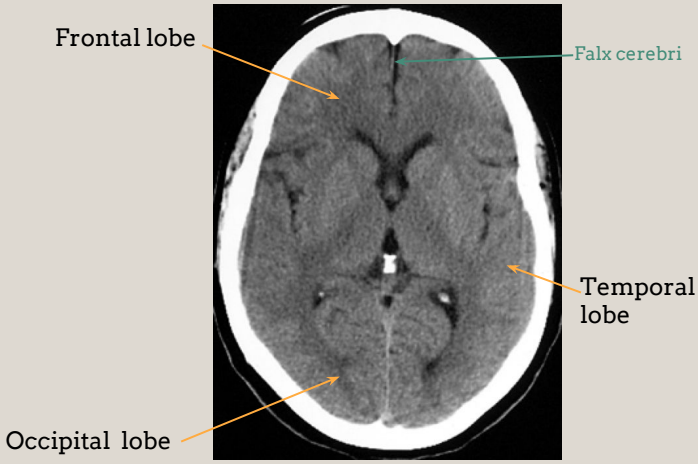
Aseel Badukhon **Adnan Almogbel**

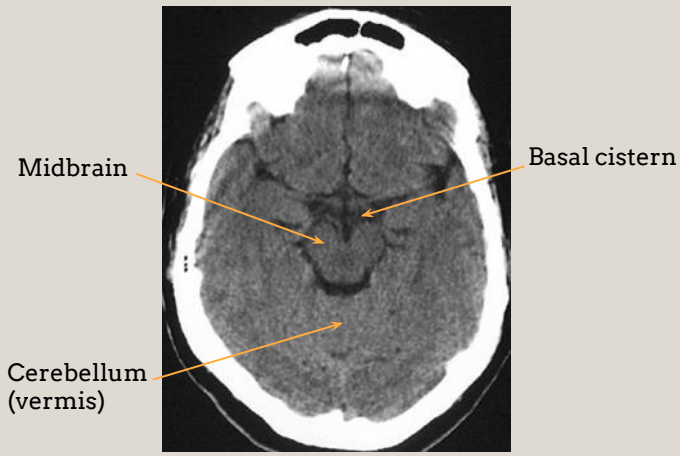
Dawood Ismail

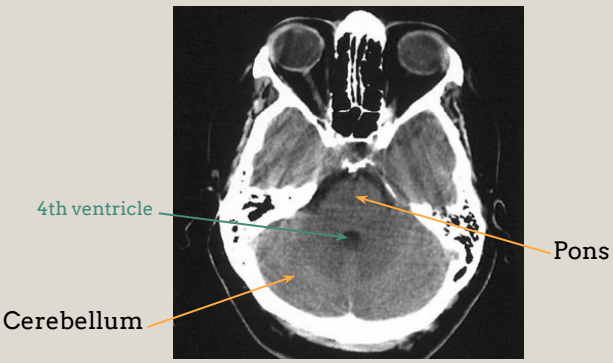
Normal Brain Imaging

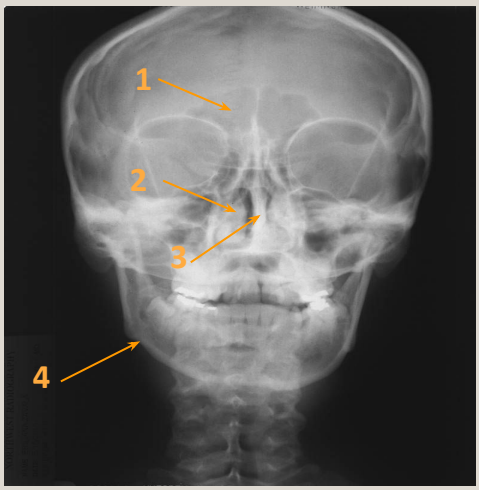
Anatomy:



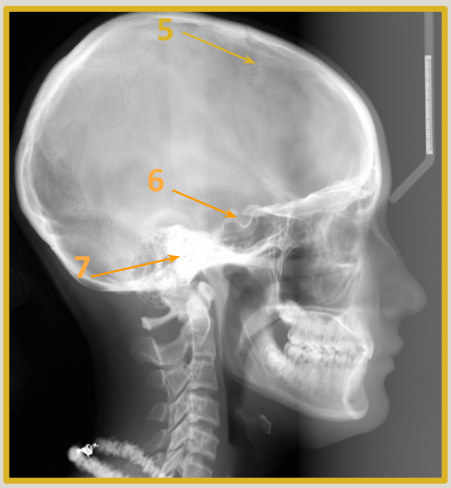








Skull AP view



Skull X-ray lateral view

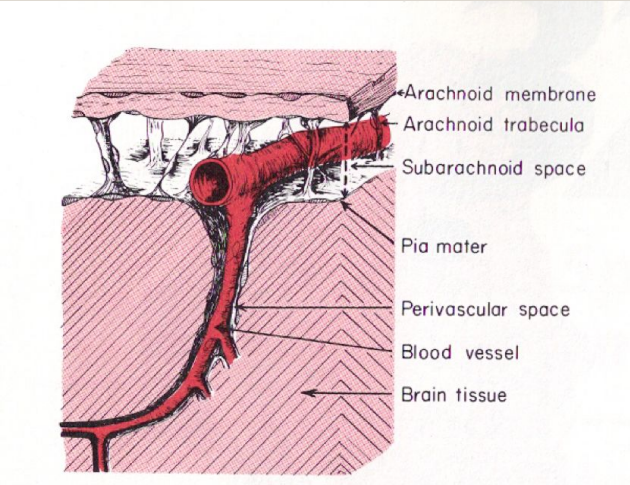
Labels:
1- Frontal sinus.
2- Ethmoid sinus.
3- Nasal septum.

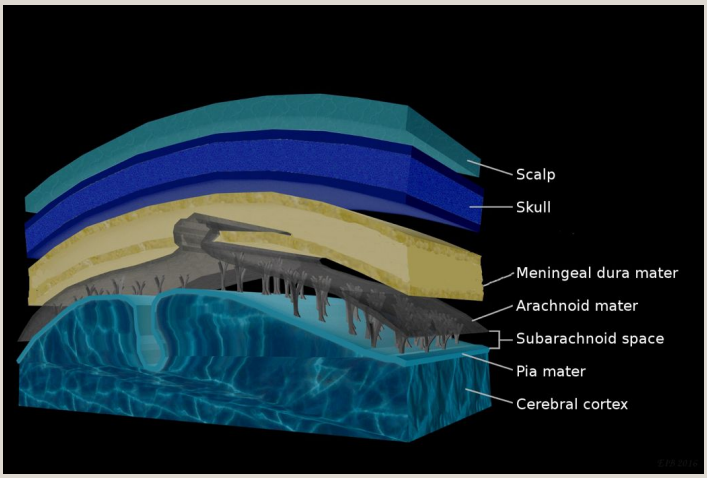
4- Mandible.
5- Coronal suture.
6- Sella turcica.
7- External auditory meatus.

436 teamwork

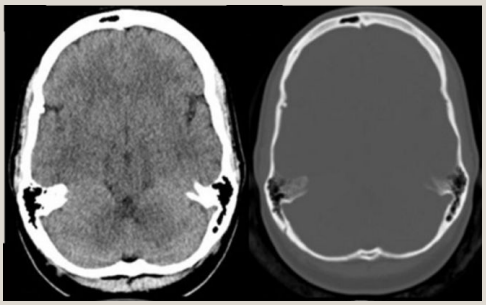
Normal Brain Imaging

Anatomy:



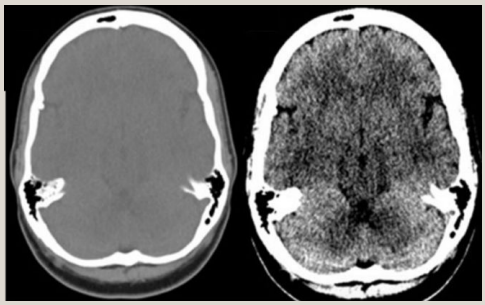


Windowing:

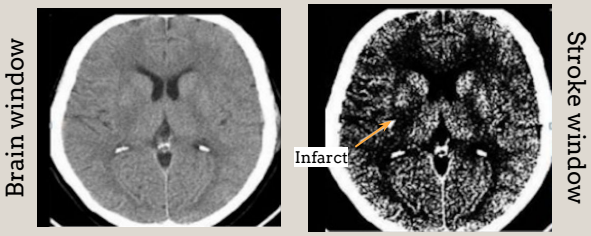


Brain window (W80, L40) | Bone window (W3000, L500)

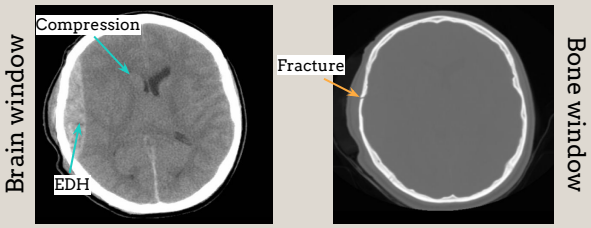
Subdural/soft tissue window is important for hemorrhage



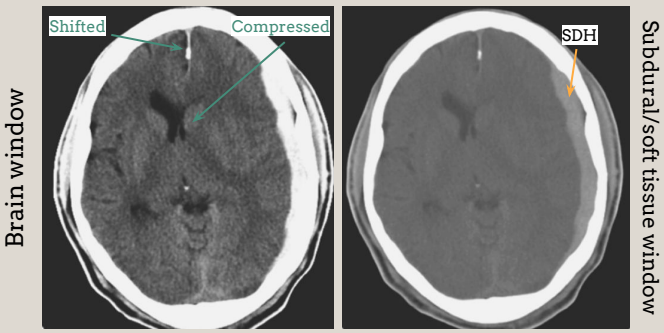
Subdural/soft tissue window (W260, L80) | Stroke window (W40, L40)



Ischemic Stroke



Acute Epidural Hemorrhage



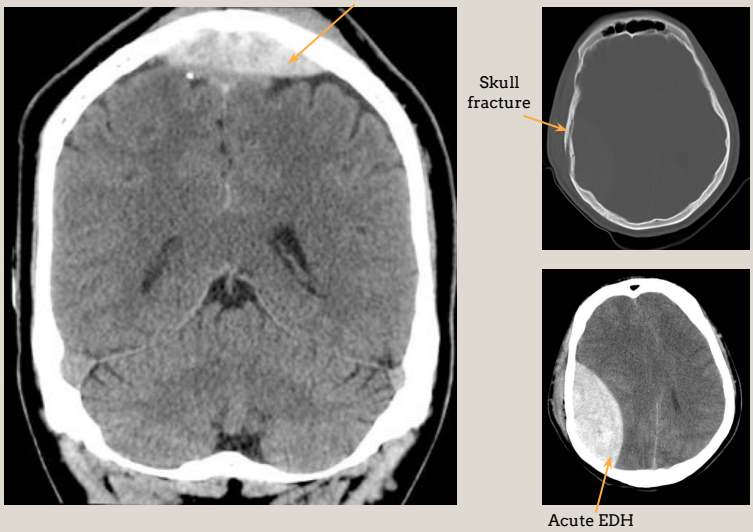
Subdural Hemorrhage

Intracranial Hemorrhage

Epidural Hematoma | Subdural Hematoma | Subarachnoid Hemorrhage | Intraventricular Hemorrhage | Parenchymal Hemorrhage

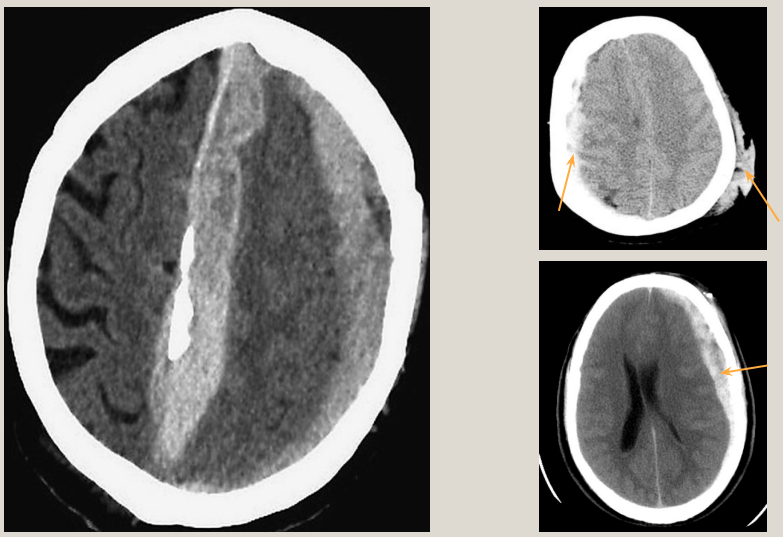
1-Epidural Hematoma:

- Lentiform collection between the dura and skull
- Almost always traumatic
- Associated with skull fracture
- Typically arterial in nature, MMA (middle meningeal artery) but could be from venous sinuses.
- It doesn't cross sutures but crosses midline



2-Subdural Hematoma:

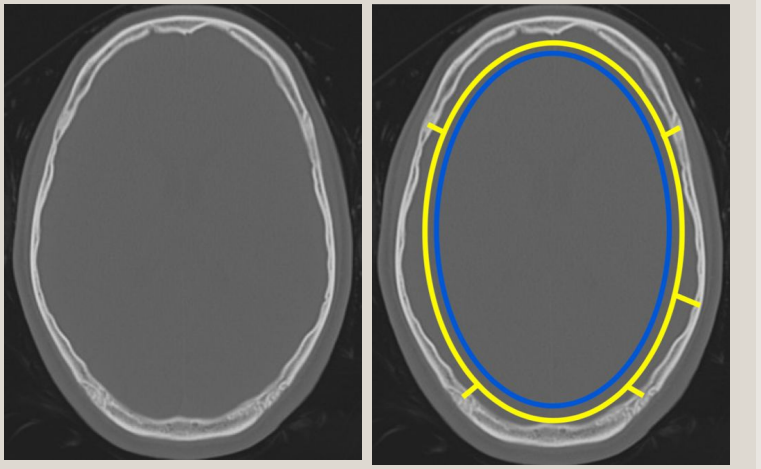
- Crescentic collection between the dura and arachnoid
- Usually caused by trauma
- Typically venous in nature
- It doesn't cross midline but crosses sutures

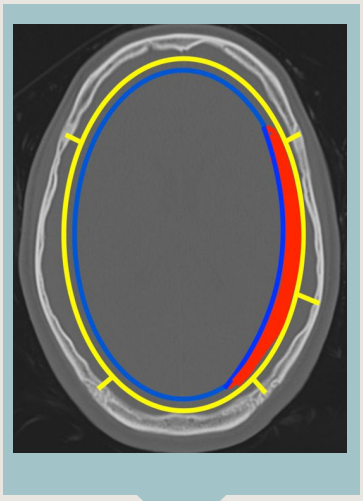


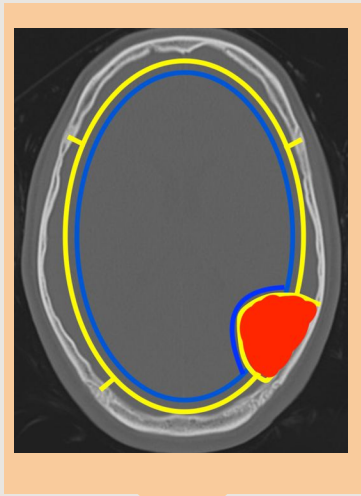
Acute SDH

Intracranial Hemorrhage

A-SDH vs EDH:

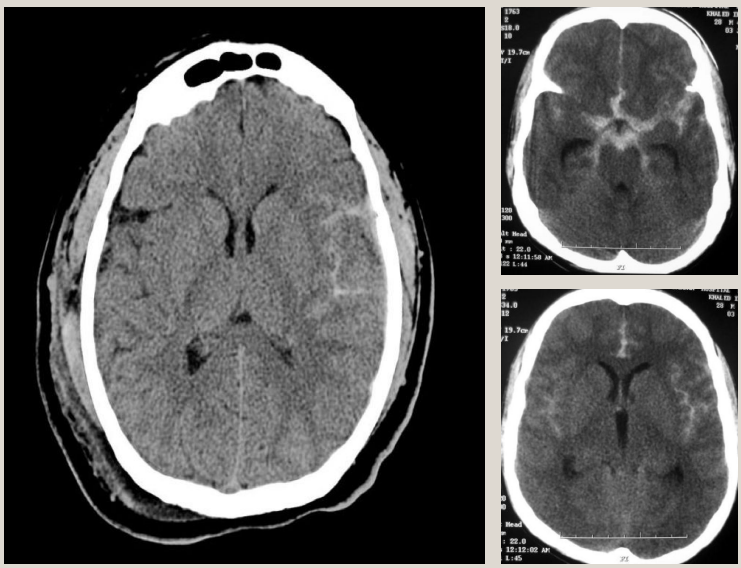






3-Subarachnoid Hemorrhage:

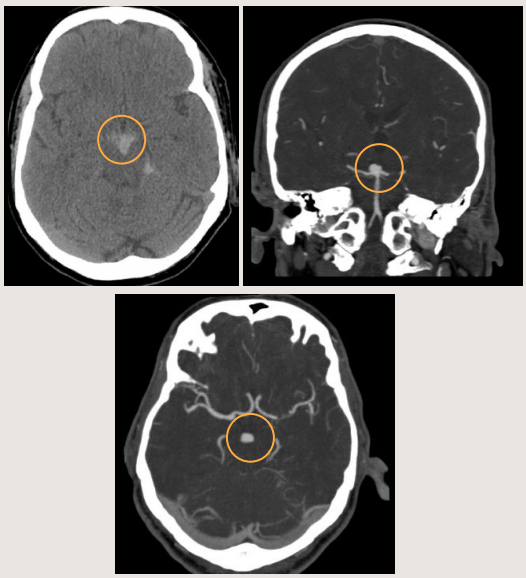
- Collects between the arachnoid and pia
- Trauma is the most common cause of subarachnoid hemorrhage (SAH)
- Aneurysm rupture is the most common cause of non-traumatic SAH
- No cause of SAH is seen in up to 20% of cases
- Clinically, non-traumatic SAH presents with thunderclap headache and meningismus



Intracranial Hemorrhage

3-Subarachnoid Hemorrhage:

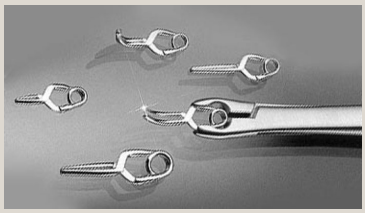
Aneurysmal SAH

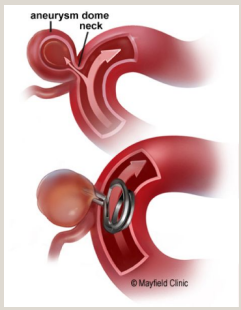


Basilar tip aneurysm (5% of aneurysms)

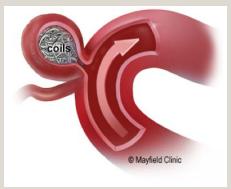
Treatment of Intracranial Aneurysms

A-Surgical Clipping:

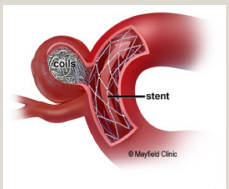




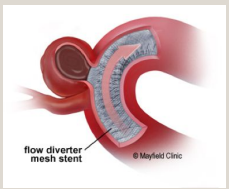
B-Endovascular treatment:



1-Coiling



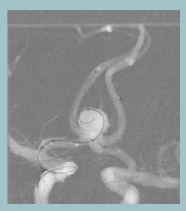
2-Stent-assisted coiling



3-Flow diverter stenting

B-Endovascular treatment

Before



During

After

4-Intraventricular Hemorrhage:

Intracranial Hemorrhage

4-Intraventricular Hemorrhage:

Intraventricular hemorrhage can be:

Primary

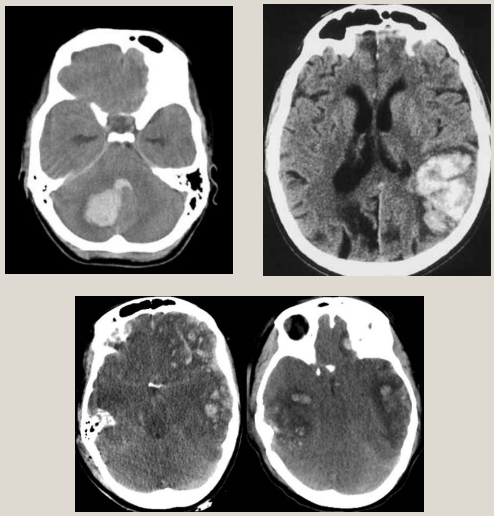
- Hypertension
- AVM malformations
- Anticoagulation
- Intraventricular tumor

Secondary

- Intraparenchymal
- SAH

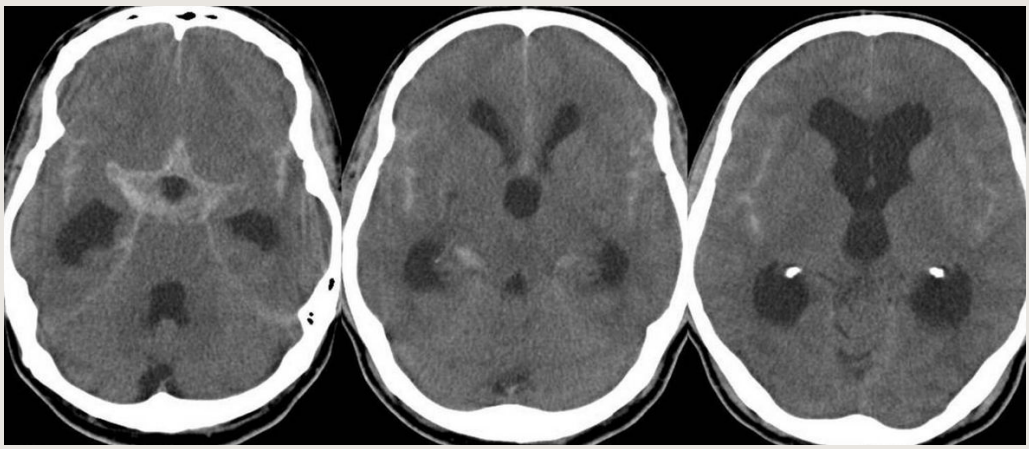
5-Parenchymal Hemorrhage:

- Can be caused by trauma
- Other causes include:
- Hypertension (usually located in basal ganglia "putamen", thalamus, cerebellum)
- AVM malformations
- Cerebral amyloid angiopathy (usually it is hemispheric; large bleeding. SWI will show you micro areas of bleeding)



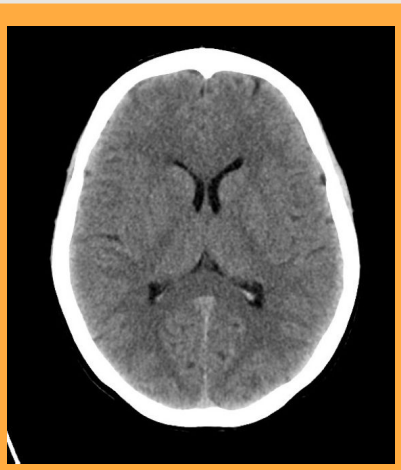
B-Intracranial Hemorrhage Complications:

Acute Hydrocephalus

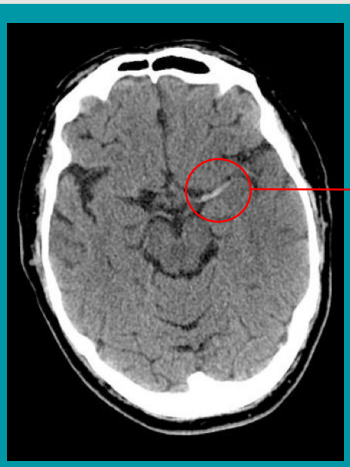


Brain Ischemia

Ischemic Stroke “time is brain!”



Normal CT is what we will see on head CT immediately after an ischemic stroke!



If you have a clot within a vessel, it will appear hyperdense on CT during this phase; this is MCA

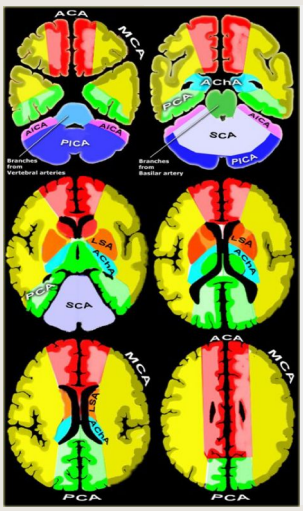
Hyperdense sign is what we will see on head CT in the HYPERACUTE phase!

Ischemic Stroke “which artery?”

A C A

M C A

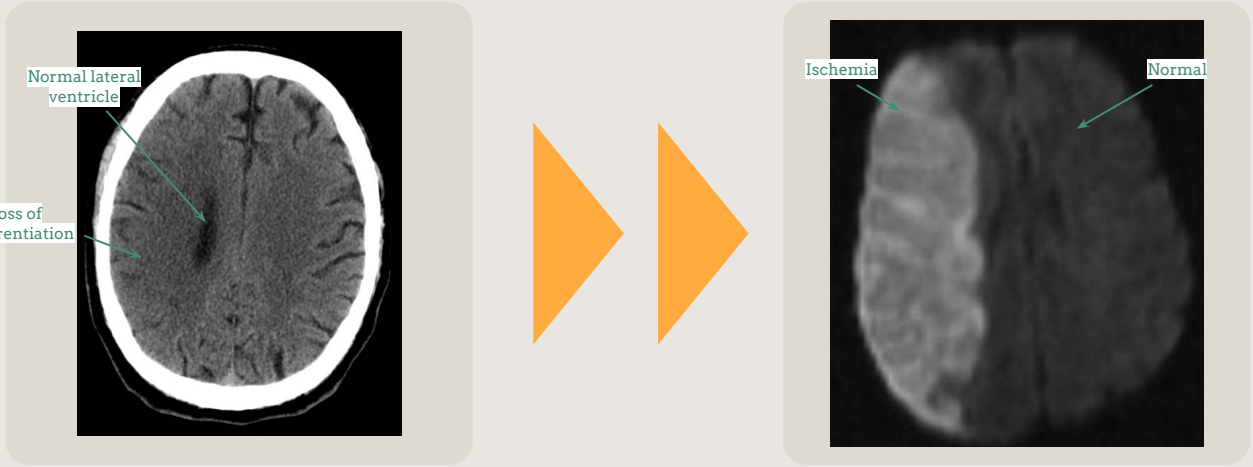
P C A



http://www.radiologyassistant.nl

Brain Ischemia

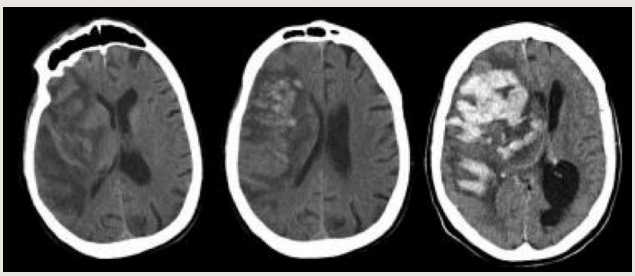
Ischemic Stroke "where is the stroke?"



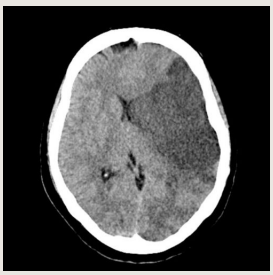
CT **MRI**

Ischemic Stroke Complications:

Hemorrhagic transformation	Malignant stroke



24 hrs after onset — Next day — A few hours after

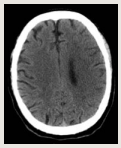


There is a mass effect and midline shift. If you did not do craniotomy patient may end up with anchal herniation

Decompressive craniotomy "treatment"

Stroke Evolution

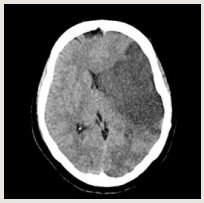
3 Hrs



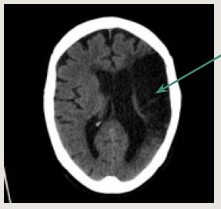
During hyperacute phase, you will see nothing but hyperdense sign. As time progresses, after 6 hrs you will be in the acute phase and you'll be able to see loss of differentiation in the cortex

12 Hrs

3 Days



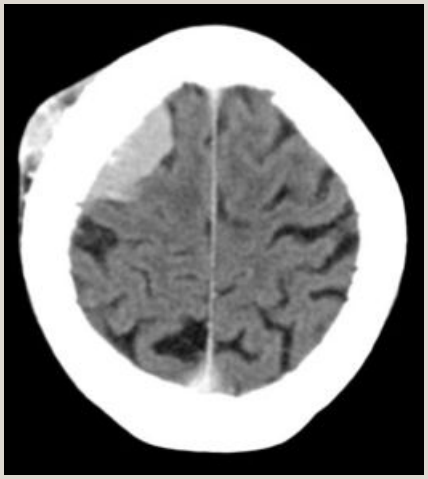
3 months



Volume loss; cystic encephalomalacia. Because of this you start to see ventricular dilation

Intracranial Tumors

Types of intracranial tumors:



A-Extraaxial masses

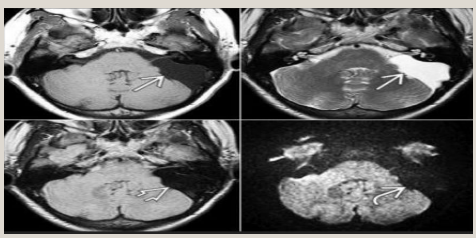
- Meningioma
- Cranial nerve schwannoma
- Metastasis

B-Intraaxial masses

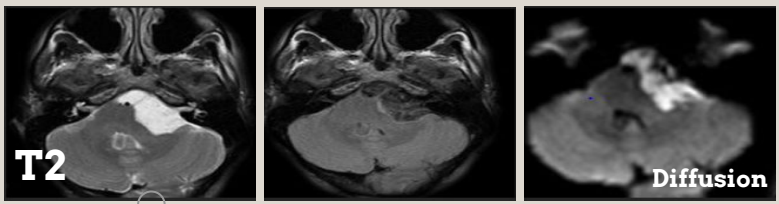
- Metastasis
- Glioblastoma
- Astrocytoma

Signs of extraaxial lesions:
-CSF cleft between brain and lesion which means the lesion is lined by CSF
-Vessels interposed between brain and lesion , pushed by mass effect
Cortex between brain and lesion so it will be related to grey matter not white matter
Dura (meninges) between brain and lesion so we can see it as flat line

Examples of intracranial tumors "436 teamwork":

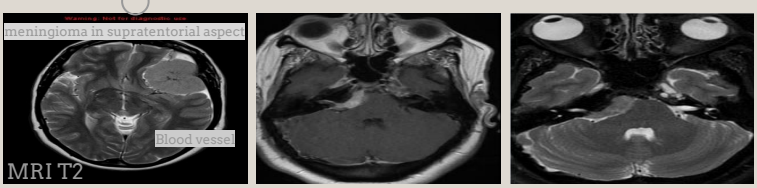


Arachnoid cyst (no need for treatment) low signal on T1WI and high signal on T2WI, without restriction on DWI (diffusion). FLARE is suppressed (FLAIR: T2 but with clear fluid suppression) if it is homogeneously suppressed, then it only contains fluid. All these characteristics are found in arachnoid cyst or epidermoid mass, and we differentiate between them by diffusion, if it is negative (dark) as in this case it is gonna be an arachnoid cyst.



Epidermoid cyst:

- High on T2WI, with restriction on DWI. It is similar to an arachnoid cyst in T1 & T2 and in the space, both of them don't enhance postcontrast. The difference however is in diffusion which will be restricted in Epidermoid (restricted diffusion → high signal on DWI.
- It needs surgical treatment so the differentiation is important.



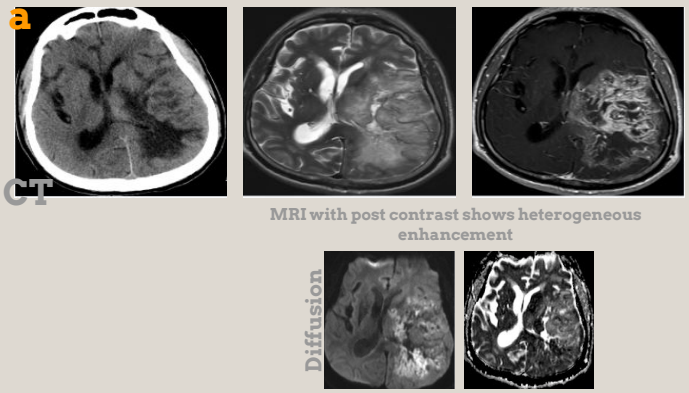
in cerebellopontine angle (infratentorial)

Meningioma:

- Extraaxial brain tumor (outside of the brain) displacing the brain.
- Enhances with gadolinium. Homogenous, unlike cystic lesions (epidermoid and arachnoid).
- Has a dural tail or flat line attachment with dura and there is CSF cleft, and the blood vessels are displaced. So the meningioma is a solid lesion which is low to intermediate signal in T2 and homogeneous enhancement post contrast. It can be supra or infratentorial.

Intracranial Tumors

Examples of intracranial tumors "436 teamwork":

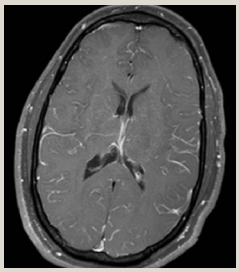


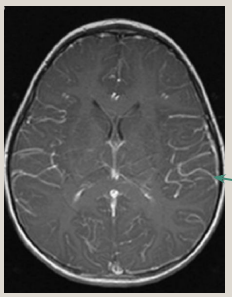
Pic a: CT shows an asymmetrical hemisphere with shifting of midline and an intracranial lesion with vasogenic edema in black on the left side. We have two types of edema in the brain: 1- Cytogenetic with stroke or arterial involvement or 2- Vasogenic edema in case of infection with abscess or TB or high grade tumor or venous involvement.
Vasogenic cerebral edema refers to a type of cerebral edema in which the blood brain barrier (BBB) is disrupted (cf. **cytotoxic cerebral edema**, where the BBB is intact). It is an extracellular edema which mainly affects the white matter via leakage of fluid from capillaries.

General findings:
1- Intra-axial large mass.
2- Partially infiltrating the corpus callosum.
3- Heterogeneous enhancement.
4- Diffusion restriction.
5- Midline shift.
So the diagnosis here is a high grade intracranial tumor (GBM).

Intracranial Infections

Bacterial meningitis

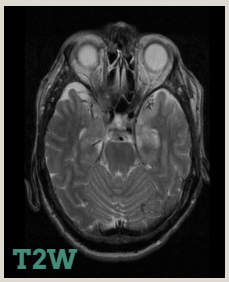


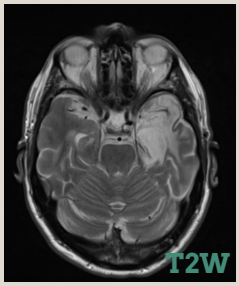


Clinically:
- Headache
- Fever
- Neck stiffness

Radiologically:
Enhancing meninges
(postcontrast). It can show complications (hydrocephalus). It can be **NORMAL!**

Herpes Encephalitis



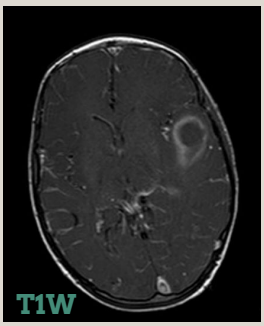


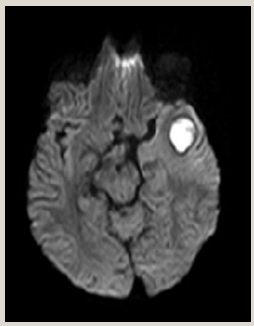
Clinically:
- Headache
- Fever
- Decreased level of consciousness

Radiologically:
Abnormal signal in the temporal lobe

-Patient could be asymmetrical (usually early)
-Usually it is bilateral.
-Two types: Type I (neonates), Type II (adults)
-They could develop cystic encephalomalacia (late)

Brain abscess





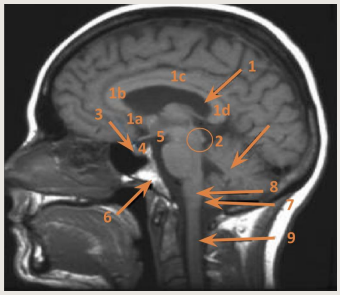
Post-contrast. Diffusion weighted image (DWI)

Clinically:
- Headache
- Fever

Radiologically:
Ring-enhancing intraaxial lesion

Extra but useful "436 teamwork"

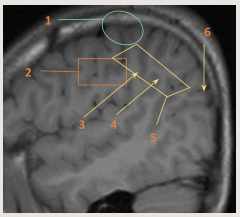
Anatomy



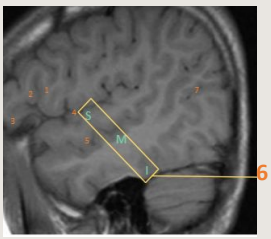
1 - Corpus Callosum.
1a - Rostrum.
1b - Genu.
1c - Body.
1d - Splenium.
2 - Superior & Inferior Colliculus.
3 - Anterior Pituitary gland (inside sella turcica).
4 - Posterior Pituitary gland (appears white because of fat).
5 - Mammillary Body.
6 - Clivus.
7- Cerebellar tonsils, herniation of this the the part is sign of increased intracranial pressure.
8- Medulla oblongata.
9- Spinal cord.

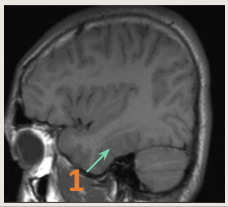
1. Paracentral lobule.
2. Subcentral lobule.
3. Supramarginal gyrus.
4. Angular gyrus of temporal lobe.
5. Inferior parietal lobule.
6. Parieto-occipital sulcus.

Each brain lobe contains multiple lobules.

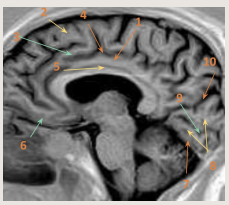


1. Pars opercularis.
2. Pars triangularis.
3. Pars orbitalis.
4. Sylvian fissure.
5. Superior temporal sulcus.
6. Transverse temporal gyri.
7. Parieto-occipital sulcus.





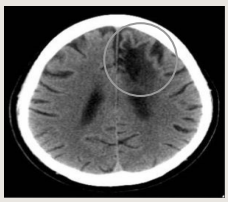
1-insular cortex.



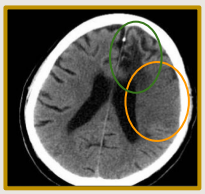
1. Cingulate gyrus.
2. Superior frontal gyrus.
3. Middle frontal gyrus.
4. Cingulate sulcus.
5. Callosal sulcus.
6. Gyrus rectus.

7.Medial occipitotemporal gyrus.
8.Striate cortex.
9.Calcarine sulcus.
10.Parieto occipital sulcus.

Ischemia



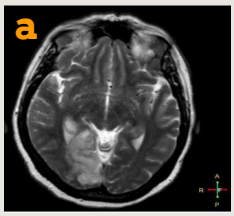
Old CT:
The lesion in the medial aspect of left frontal lobe, has a similar density of CSF (dark) which means it is an old infarct which is called a cystic encephalomalacia. Being old means there is no mass effect (no edema), and we can see that the sulci are maintained.

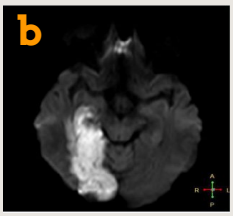


Recent CT:
In the same picture, we can see two lesions, a new acute infarction and an old infarction.
The sign of volume loss is obvious with the old one, while signs of an increase in volume and edema and mass effect are obvious in the acute one.

In this case:
1- Chronic infarction of the left ACA.
2- Acute infarction of the left MCA.

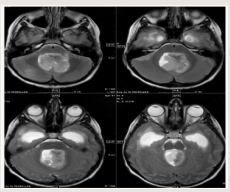
The signs of acute infarction are:
1- Diffuse hypodensity (dark).
2- Sulcal effacement.
3- Loss of gray-white differentiation.





- Right occipital gyral and inferior temporal swelling and altered signal in cortical and subcortical area exhibiting restricted diffusion in DWI, bright signal in T2.
- MRA reveals occluded P1 segment of right PCA.
- Diagnosis: Right PCA territory acute cerebral infarction. If the patient present with sudden onset.
- If the same picture occurs with more than one territory with no history of sudden onset we can think of herpes encephalitis.
- **Pic C:** MRI angiography, there is filling defect in right branch of PCA.

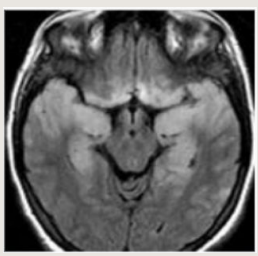
Tumors



- Infratentorial midline mass in child, we have four main differential diagnoses (medulloblastoma - pilocytic astrocytoma - ependymoma - brain stem glioma). **The medulloblastoma** has a unique characteristic that differentiates it from others. **It is the only one which will appear hyperdense in CT**, and low to intermediate in T2, and diffusion restriction.
- Medulloblastoma is the most common malignant brain tumor of childhood. They most commonly present as midline masses in the roof of the 4th ventricle with associated mass effect and hydrocephalus.
- Medulloblastoma on CT often appears as a mass arising from the vermis, resulting in effacement of the fourth ventricle / basal cisterns and obstructive hydrocephalus. They can also occur more laterally in the cerebellum.

- **Treatment** typically consists of surgical resection, radiation therapy, and chemotherapy. In general, the tumors are quite radiosensitive.

Infection



- Typical pattern of herpetic encephalitis which is bilateral.
- High signal in T2.
- It starts unilateral then becomes bilateral.
- In this picture it involves temporal lobes and hippocampus and part of the frontal lobes which is a typical distribution of herpes.
- We can see swelling due to edema and infection.

Coronal Sagittal

1- Ring enhancement lesion: abscess.
- In sagitta, two vertebrae with soft tissue component.
- In coronal post contrast, we can see multiple large paravertebral abscesses.

The difference between the tumor and infection in spine, that the infection spreads through the ligament (subligmental) while a tumor will be confined within the vertebral bodies.

Summary "436"

Approach to brain mass:

1. CT → MRI → MRI sequences (T1,T2,post contrast, diffusion, and perfusion).
2. Location.
3. Pattern.

Infarction:

1. Diffuse hypodensity (dark). 2. Sulcal effacement. 3. Loss of gray-white differentiation.

- ## Extra-axial lesion:

1. CSF cleft. 2. Vessels interposed between brain and lesion.
3. Dura (Meninges) between brain and lesion (flat line).

Arachnoid cyst & Epidermoid :

Both of them appear (low signal on T1WI and HIGH signal ON T2WI)
we differentiate by diffusion (DWI), with restriction → Epidermoid / without restriction → Arachnoid.

Meningioma:

it is a solid lesion which is low to intermediate signal in T2 and homogeneous enhancement post contrast. It can be supra or infratentorial or within cerebellopontine angle.

- ## Intra-axial lesion:

GBM:

High signal in T2 with mass effect & midline shift. We can use perfusion to confirm the diagnosis.

Medulloblastoma:

Infratentorial midline mass in child .
Hyperdense in CT, and low to intermediate in T2, and diffusion restriction.

Brain Abscesses:

In post contrast → smooth regular wall unlike what we see in GBS.
If it is very bright in diffusion we confirm the pyogenic abscesses.
Restricted intraparenchymal Continuous ring enhancement lesion → abscess.

Chiari-II malformation:

Small size posterior fossa, narrow 4th ventricle, deformity of the clivus, tonsillar herniation, corpus callosum dysgenesis. Usually present with myelomeningocele.

Herpetic encephalitis:

Typical distribution of herpes is involving temporal lobes, hippocampus and part of frontal lobes. it can be Bilateral. We can see swelling due to edema and infection.

Spinal cord:

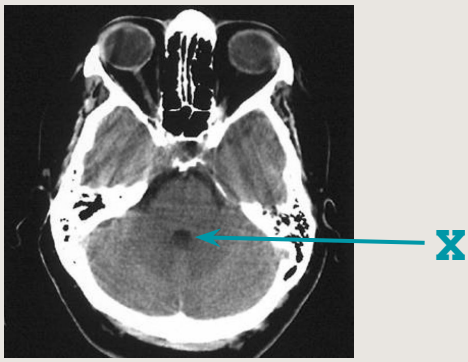
- **Bacterial spondylodiscitis:** Infection starts in the vertebral body adjacent to the endplate, then proceeds to the disc, and eventually spreads to both adjacent bodies.
- **TB spondylitis:** Infection usually starts in the anterior vertebral body and spreads under the anterior longitudinal ligament to adjacent vertebrae.

QUESTIONS

1. If you got a CT scan of an ischemic stroke patient 3 days after onset. Which of the following will you see?

a) loss of differentiation
c) malignant stroke
b) normal
d) hemorrhage

2. "X" is



a) 4th ventricle
c) 3rd ventricle
b) pons
d) aneurysm

3. Hypertensive hemorrhage is commonly seen in?

a) thalamus
c) spinal cord
b) brainstem
d) hemispheric

4. One of the following tumors is seen hyperdense in CT

a) glioblastoma
c) medulloblastoma
b) astrocytoma
d) ependymoma

1-C
2-A
3-A
4-C

help us improve with your feedback:

RadiologyRadiology437@gmail.com

We would be happy, if you leave your feedback click Here !

References

✓ Slides
✓ 436 Teamwork

slidesgo

You did it !